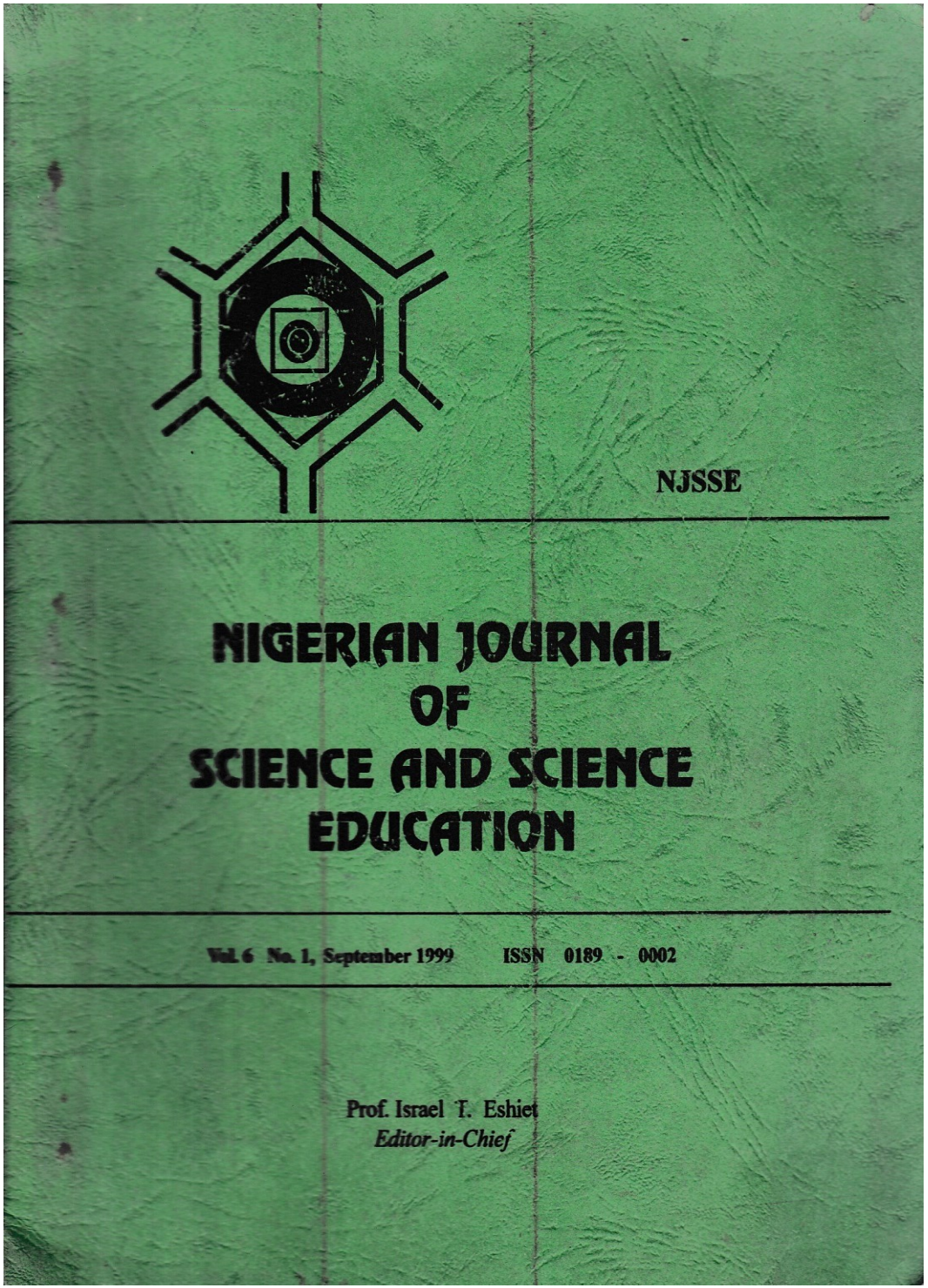




# KNOWLEDGE OF MATHEMATICS AS A PREDICTOR OF STUDENTS' PERFORMANCE IN PHYSICS

**Fidelis A. Onwioduokit** *(Ph.D., MSTAN)*
***Department of Science Education***
***University of Uyo***
***Uyo, Akwa Ibom State***
***Nigeria.***

***Abstract***

*The study investigated the relationship existing between students' performances in physics and that in mathematics from 1991-1995. A total of 732 candidates were used in the study. The instrument used was the Senior Secondary School Certificate Examination results for the period specified. The results showed that there exists a positive relationship between students' performances in physics and that in mathematics. This was explained from the fact that some aspects (concepts) in physics are mathematics-oriented. They contain some mathematical principles and concepts. However, it was discovered from the study that a student does not perform in physics as much well as he performs in mathematics.*

## Introduction

It is common in schools to find teachers who intimidate physics students with an assertion that physics is mathematical and that without a good knowledge of mathematics one cannot do well in physics. This position emanates, probably, from the observed close relationship existing between the two subjects (Fakuade, 1977; Daramola, 1982; Onwuka, 1986; and Gholap and Sansanwal, 1987). Mathematical concepts such as algebraic expressions, mensuration, quadratic equation etc. aid understanding of physics concepts such as motion, optics and waves among others. The knowledge of graph plotting in mathematics is also capable of enhancing the performance of students in practical physics.

Generally, in both theory and practice, mathematics aids the understanding of physics by providing numerical shorthand for concise and precise statement as well as enhancing relational and logical think-

ing required in physics (Schofield and Winter, 1975).

At the higher level of the study of physics, mathematics is most useful in the field of study known as theoretical physics. Because of the prominent role of mathematics in this branch of physics, the branch is also referred to as mathematical physics. It is perhaps at this stage that sound knowledge of mathematics in the understanding of physics becomes inevitable.

Mathematics has, generally been recognised in science as the service subject (Nima, 1970; Webb, 1973; Ogunsulive, 1977 and Fakuade, 1977).

Furthermore, research studies in physics education (Onwuka, 1986; and Sansanwal, 1987), comparing the relative performance of students of high and low mathematics ability have shown a relatively better performance of students of high mathematics ability. Unfortunately, most physics students have been found deficient in their mathematical background of physics principles they were required to learn (Tones, 1972 and George, 1974 and Gholap and Sansanwal, 1987).

However, while emphasizing the role of mathematics in physics, it should be noted that physics is not mathematics. The two subjects while having certain things in common are distinct from each other. The fact that one is good in mathematics may not necessarily mean that he/she is equally good in physics.

**Purpose of the Study**

The purpose of this study is two fold. Firstly, to quantify the extent of relationship existing between Senior Secondary Physics students' knowledge of mathematics and their performance in physics as shown in their performance at the Senior Secondary Certificate Examination (SSCE) from 1991-1995 in Obubra Local Government Council. Secondly, to show how one's performance in mathematics could be used to predict his/her performance in physics.

**Research Question**

The study attempted to answer the following questions:

(1) What relationship exists between students' performance in physics and mathematics from 1991-1995 in Obubra Local Government Area of Cross River State?

(2) Using the performance for the years specified which year were students' performance in physics the best?





(3) Based on the performance of students in mathematics how can the performance of students in physics be predicted?

**Research Hypotheses**

In the study the hypothesis tested was that, there exists no significant relationship between students' performance in mathematics and that in physics, from 1991-1995.

**Research Method**

This study employed a correlational design. The sample of the study was made up of all students in five (5) out of eight (8) Secondary Schools in Obubra Local Government Area of Cross River State who registered for and took physics and mathematics in the Senior Secondary School Certificate Examination (SSCE) from 1991-1995.

There were 115 of such candidates in 1991, 143 in 1992, 145 in 1993, 150 in 1994 and 179 in 1995. This gave a total of 732 candidates as the sample of the study.

The main instrument used in the study was the Senior Secondary School Certificate Examination (SSCE) results from 1991-1995 in physics and mathematics.

**Scoring of Instrument**

Scoring was done based on the grades obtained by the subjects at the SSCE such that different grades of performance attracted different score as shown below:

| Grades | | Marks |
|---|---|---|
| F | = | O |
| $P_8$ | = | 1 |
| $P_7$ | = | 2 |
| $C_6$ | = | 3 |
| $C_5$ | = | 4 |
| $C_4$ | = | 5 |
| $A_3$ | = | 6 |
| $A_2$ | = | 7 |
| $A_1$ | = | 8 |

For instance if two candidates had $C_6$ and $P_8$, respectively, the sum of the two scores from the grades will be 3 + 1 = 4. In this way the scores in each subject discipline and for each year were computed and analysed.

**Data Analysis and Results**

Data generated from the instrument used were analysed to obtain pearson product-moment correlation coefficient as the index of relationship existing between students performance in mathematics and physics. Moreover, students' performance in physics (Y) was predicted using the equation Y = A + B (X).

Where Y = Predicted performance in physics
A = Constant
B = Regression coefficient
X = Performance in mathematics

**Table 1: Pearson Product-Moment Correlation Coefficient Showing the Relationship Between Students' Performance in Mathematics and Physics from 1991-1995.**

| Year | Variable | N | ΣX or ΣY | ΣX² or ΣY² | ΣXY | r | Decision at P< 05 |
|---|---|---|---|---|---|---|---|
| 1991 | Mathematics (X) and Physics (Y) | 115 115 | 397 311 | 26055 15817 | 16233 | 0.38 (0.17) | * |
| 1992 | Mathematics (X} and Physics (Y) | 143 143 | 369 299 | 26795 17887 | 20035 | 0.81 (0.16) | * |
| 1993 | Mathematics (X) and Physics (Y) | 143 145 | 307 273 | 18437 16098 | 16597 | 0.92 (0.16) | * |
| 1994 | Mathematics (X) and Physics (Y) | 150 150 | 368 315 | 31090 19631 | 21971 | 0.77 (0.17) | * |
| 1995 | Mathematics (X) and Physics (Y) | 179 179 | 437 350 | 52997 25506 | 30344 | 0.17 (0.14) | * |

Note: 1. Figures in bracket are critical values of r
2. * = Significant at P< .05

Table 1 shows that:

1. For all the years considered, 1991-1995, there existed a positive significant relationship between students' performances in mathematics and their performances in physics. The critical r value for each year is less than the respective calculated value.

2. The strength of relationship observed between students' performances in mathematics and physics increases gradually from 1991 through 1993. It then decreases from gradually from 1993 through 1995.





3. The strength of relationship between performances in mathematics and physics is found to be highest in 1993 and lowest in 1991.

**Table 2: Predicted Scores of Students' Performance in Physics Based on Actual Scores in Mathematics**

| Actual Scores in Maths (%) | 1991 A = 21.57 B = 0.29 | Predicted Scores in Physics (Y) 1992 A = 5.89 B = 0.67 | 1993 A = 1.12 B = 0.92 | 1994 A = 11.83 B = 0.57 | 1995 A = 18.49 B = 0.42 |
|---|---|---|---|---|---|
| | r = 0.38 | r = 0.81 | r = 0.92 | r = 0.77 | r = 0.67 |
| 40 ($P_7$) | 33.35 | 32.55 | 35.60 | 34.50 | 35.29 |
| 56 ($C_6$) | 38.00 | 42.22 | 50.00 | 43.50 | 42.02 |
| 65 ($A_3$) | 40.70 | 49.00 | 58.60 | 48.66 | 45.80 |
| 70 ($A_1$) | 42.00 | 52.55 | 63.00 | 51.50 | 47.90 |
| | $r^2$ = 0.14 | $r^2$ = 0.66 | $r^2$ = 0.85 | $r^2$ = 0.59 | $r^2$ = 0.49 |

From Table 2 above, it is observed that:

(1) The predicted scores in physics are less than the actual mathematics scores.

(2) Even for high indices of relationship, students' predicted performance in physics is low.

(3) The highest predicted performance occurred in 1993 where there was the highest index of relationship. Even in that year, predicted performance in physics is not as good as the performance in mathematics.

(4) Excepting for 1993, a student with even an $A_3$ level of pass in mathematics had a predicted performance of a pass grade in physics.

(5) Even with a high index of relationship as 0.67 in 1995, a student with $A_1$ level, of pass in mathematics has a predicted performance in physics as low as about 48%.

**Discussion of Results**

The study has shown that there exists a positive relationship be-

tween students' performance in mathematics and that in physics for the period considered in the study. The observed relationship may have resulted from the mathematical concepts and principles embedded into the SSS physics curriculum.

Mathematical principles such as those involving algebraic expression, quadratic equations, mensuration etc. are directly applicable in the teaching/learning of physics. This finding is in consonant with some precious studies (Onwuka, 1986 and Sansanwal, 1987) that portrayed mathematics as a useful tool for a good performance in physics.

Be that as it may, the findings of this study however show that a good students in mathematics may not be equally good in physics.

Table 2, particularly portrays that a student with a pass at credit level and above may only manage to pass in physics. This is probably because physics is not mathematics contrary to what some teachers use to say, frightening physics students. The fact of physics having some mathematics contents is not deniable, but physics contains more things than mathematics.

A student who is good in mathematics may be smart in understanding the areas of physics that is mathematics oriented and could solve quantitative problems associated with them. The same student may not be able to understand the physics of the materials under study. The percentage of variances in the performance in each year considered in the study (1991-1995) are 14%, 66%, 85%, 59% and 49% respectively. This implies that other factors do influence students' performance in physics to an extent ranging from 15% to 86% depending on the year concerned. This indeed is a wide spectrum.

**Conclusion and Recommendation**

Considering the outcome of this study, it could be concluded that while mathematics may aid the performance of students in physics it does not determine it. A student who has credit in mathematics does not necessary have a credit in physics. Physics is distinct and contains more mathematical principles and formulae.

It is therefore recommended that physics teachers should cease from intimidating physics students with the notion that physics is mathematics. They should rather expose their students to relevant mathematics content that are capable of aiding students' understanding of such mathematics related concepts and should teach physics on its own merit.

It is also recommended that further studies be carried out to show the dependence of mathematics on physics as well as show other factors on which students' performance in physics depend.





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